

MISSISSIPPI'S BEST MANAGEMENT PRACTICES For WETLANDS



JANUARY, 1991

**MISSISSIPPI'S
BEST MANAGEMENT PRACTICES
FOR
WETLANDS**

January, 1991

TABLE of CONTENTS

ACKNOWLEDGEMENT

INTRODUCTION

WETLANDS.....1

HYDROLOGY OF MISSISSIPPI.....4

SILVICULTURAL TECHNIQUES FOR WETLANDS.....6

 Regeneration of Bottomland Hardwoods

 Natural Regeneration of Bottomland Hardwoods.....6

 Artificial Regeneration of Bottomland Hardwoods.....14

 Regeneration of Other Desirable Wetland Species.....19

 Harvesting Best Management Practices.....21

 Logging/Access Roads Best Management Practices.....24

STREAMSIDE MANAGEMENT ZONES (SMZs).....26

MISCELLANEOUS MANAGEMENT OPTIONS.....29

WILDLIFE HABITAT.....31

DESCRIPTION OF FORESTED WETLANDS.....34

REFERENCES AND SUGGESTED READING

ACKNOWLEDGMENT

The publishers acknowledge with sincere appreciation the following contributors whose understanding, input and cooperation helped make this document possible:

Steve Corbitt, Mississippi Forestry Association
Walter Dennis, International Paper Company
Robert Fry, Weyerhaeuser Company
Freddie Jordan, Mississippi Forestry Commission
Frank Miller, Mississippi State University
Robert S. "Sid" Moss, Mississippi Forestry Commission
Seth Mott, U. S. Fish and Wildlife Service
Don Nevels, Mississippi Forestry Commission
Tony Parks, Anderson Tully Corporation
Mike Rogers, Scott Paper Company
Dan Sims, U. S. Forest Service
Gene Sirmon, U. S. Forest Service
Frank Shropshire, Mississippi Forestry Commission
Bill Tomlinson, Wildlife Biologist, Consultant
Mississippi Forestry Commission Board
Stoneville Hardwood Research Laboratory

Mississippi Forestry Association
Environmental Affairs Committee - Wetlands Task Force

MISSISSIPPI'S BEST MANAGEMENT PRACTICES FOR WETLANDS

INTRODUCTION

Mississippi's bottomland hardwood forests and "wetlands" are productive ecosystems with multiple functions and ecological values that can be managed for commercial timber production without compromising this valuable resource. This publication deals with the management of these sites in order that they may continue to provide this ecological value. The reader should keep in mind that sites classified as bottomlands are not necessarily "wetlands" in the strictest sense. However, in order to maintain ecological productivity there is little or no difference in the implementation of proper management techniques.

Proper management of these sites is essential to provide far reaching benefits including timber production, wildlife habitat, water tolerant non-commercial plant species, recreation, hydrologic functions, e.g. - dissipation of flood waters, estuarine water balance, filtration, and stream bank protection.

Navigable rivers and streams are traditionally and legally "public domain," therefore, silvicultural practices on lands adjoining waterways directly effecting the function and quality of such waters are subject to public law and public review.

Conservation and proper management of these wetland ecosystems is the objective of much current and potential regulatory activity such as the Water Quality Act Amendment of 1987, the final report of the National Wetlands Policy Forum, and the President's Executive Order 1990. All conclude that Best Management Practices (BMPs) should be implemented to control non-point source water pollution on wetlands and bottomland sites.

These BMPs, which are specifically designed for maintaining bottomland hydrologic functions, have been recognized as the best strategies for enhancement of wildlife habitat, maintenance of both woody and herbaceous vegetation, and for productive management of the delicate wetland environment. Properly implemented BMPs are entirely compatible with timber production, thus maintaining the socio-economic values that are derived from wetland and bottomland ecosystems.

The main objectives of BMPs for managing bottomland forest ecosystems is to

maintain the integrity and functions of the environment by protecting stream banks, water courses and hydrologic functions, and to minimize erosion.

In 1972, the U.S. Congress passed the Federal Water Pollution Control Act Amendments (better known as the Clean Water Act). This act established water quality control goals and set the course by which federal and state efforts were directed to attain desirable water quality by 1983.

Section 208 covered the non-point pollution part with three principle areas including forestry/road construction, harvesting, and site preparation. The principle pollutant from forestry operations was identified as soil erosion sediment. The non-point source of sediment from erosion is a result of excessive water run-off or site alterations.

The Environmental Protection Agency (EPA) is assigned responsibility for the administration of all Federal Acts dealing with water quality. EPA maintains that the best way to control non-point source pollution is to minimize sediment production by use of certain management and silvicultural techniques that prevent the generation of erosion at its source. These preventive practices are considered to be the Best Management Practices (BMPs).

EPA has assigned administrative responsibility to the individual states, giving them the task of developing a plan to accomplish mandates of Section 319 of the Water Quality Act of 1987. Through guidelines such as these, BMPs are designed to conserve soil and water by preventing erosion and maintaining site productivity while maximizing timber production, specific wildlife management objectives and environmental values.

For the purpose of this publication emphasis is directed to those forested areas in Mississippi referred to as bottomland forest and wetlands, where these sites are the point of water quality protection. Some reference is made to sites suitable for mitigation or reclamation to forest from other land uses.

Mississippi's bottomland hardwood/wetlands forests are recognized as one of the most vital of the state's natural resources. Much of the area categorized as wetlands is forested primarily with oak/gum/cypress or ash/cottonwood/sugarberry sites. It is to these sites that this document primarily directs its attention.

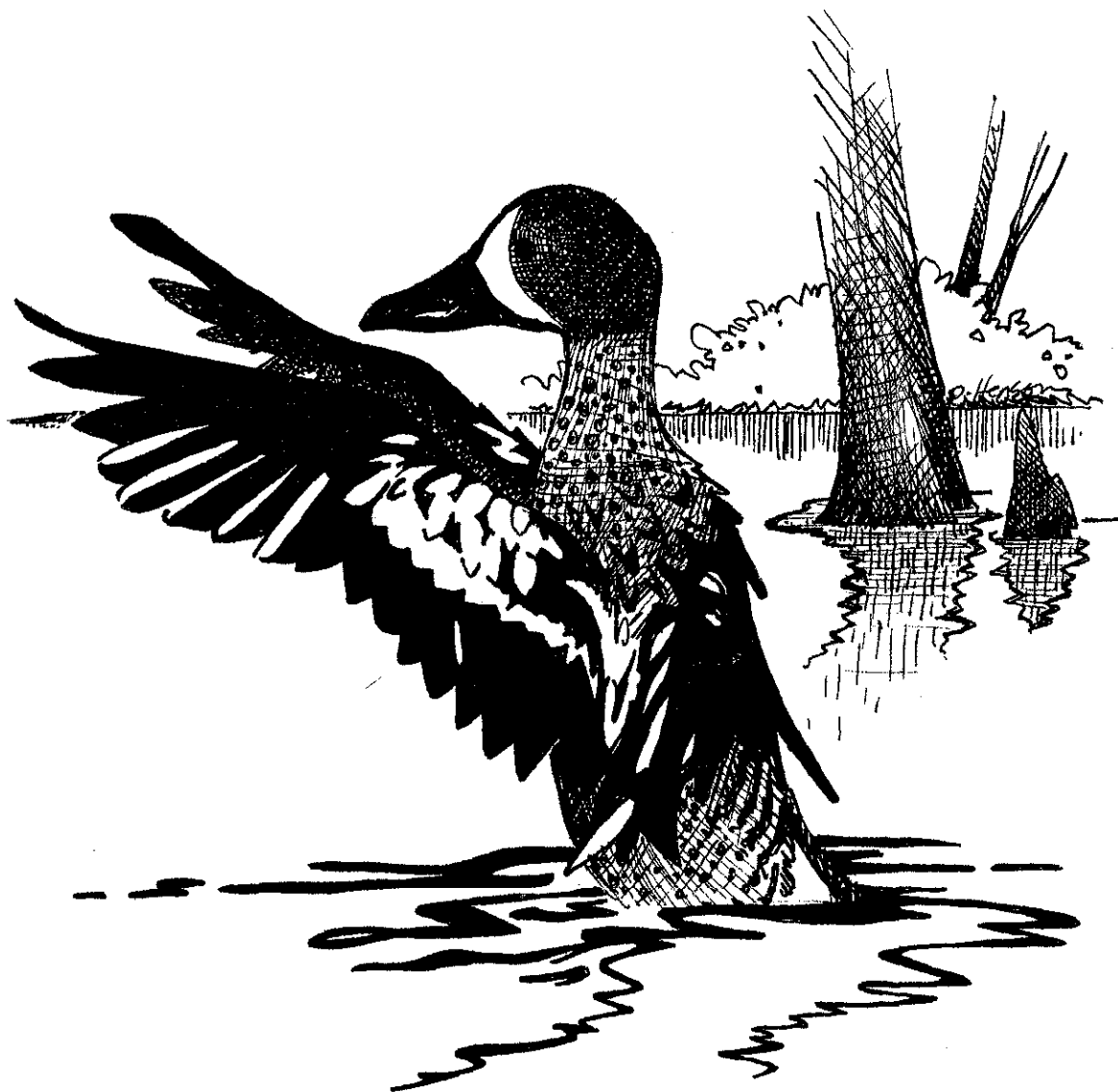
The importance of this forested wetland resource, which totals 3.7 million acres or about 22% of the 16.98 million acres of the state's commercial forestland, must not be minimized. Proper silvicultural techniques are all-important to the enhancement and management of these bottomland sites. These figures are based on the 1987 Forest Service Inventory data of acreages by site classes.

Forested wetlands have multiple values that have high social and economic

significance to today's population. Among them are timber, wildlife, water, and recreation. Other environmental and socio-economic benefits such as water quality, erosion control, aesthetics and ground water recharge are benefits that are normally not considered by the general public. The application of multiple-use management through proper use of BMPs in these forest types is an opportunity to protect and enhance this natural resource.

The silvicultural practices and related activities associated with intermediate timberland manipulation, harvesting and regeneration of forested wetland sites described as BMPs in this publication are intended to supplement the general handbook, *Mississippi's Best Management Practices* (April 1989).

The guidelines set forth in this wetlands publication meet or exceed the requirements established in Section 404 of the Clean Water Act. For further information regarding provisions of Best Management Practices consult the **Federal Register** - Vol. 53, No. 108, June 6, 1988, page 20775.



"WETLANDS"

Ownerships classified under the broad heading of wetlands and/or bottomlands are very sensitive to non-point source pollution from silvicultural management practices.

Silvicultural practices implemented for wetland sites have a direct impact on water quality. In addition, the treatments that are carried out on upland sites have indirect impact on water quality of wetlands through natural drainage and waterflow.

Wetlands Definition

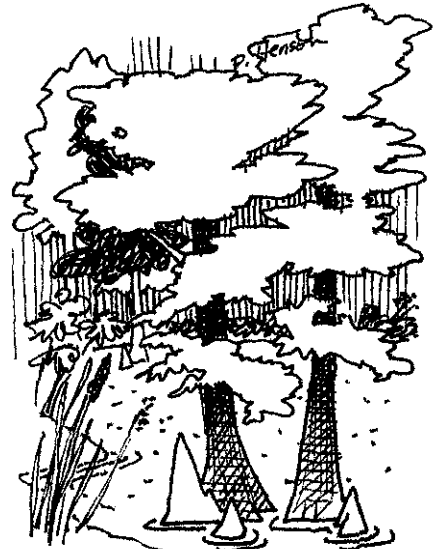
Several definitions of "wetlands" have come from past research studies and from state and federal agencies. To use the jurisdictional wetland definition from the Water Quality Act of 1987 could cause controversy between public and private entities, possibly resulting in litigation. This definition is as follows:

"Wetlands mean those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

As you may note, this definition is ambiguous so as to leave a wide margin for interpretation. Common today, but unfortunate, is the practice of leaving the interpretation of its intent and purpose up to the courts.

The determination of a wetland from the standpoint of this handbook and its BMPs will be made based on a comprehensive identification and delineation technique as agreed upon by four agencies at the Federal level.

Under the recommendations made by the National Wetlands Policy Forum a concise workable "wetlands" definition has been formulated by federal agencies involved with regulations. The four federal agencies assigned this responsibility were designated as: 1) U.S. Army Corps of Engineers (CE), 2) Environmental Protection Agency (EPA), 3) U.S. Fish and Wildlife Service (USFW), and 4) Soil Conservation Service



(SCS). Each of these agencies had their own techniques and methodology of identifying wetlands.

A general consensus has been formulated by these agencies and published in the ***Federal Manual for Identifying and Delineating Jurisdictional Wetlands*** (January 1989). This manual addresses several definitions of wetlands for various laws, regulations, and programs, all of which use the same basis criteria for delineation and identification. These definitions listed are in reference to their guiding document.

Section 404 of the Clean Water Act

The following definition of a wetland is the regulatory definition used by the EPA and CE for administering and regulating the Section 404 permit program.

"Those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

Food Security Act of 1985 (Conservation Reserve Program)

The following wetland definition is used by the SCS for identifying wetlands on agricultural land in assessing farmer eligibility for U.S. Department of Agriculture program benefits under the "Swampbuster" provision of this Act.

"Wetlands are defined as areas that have a predominance of hydric soils and that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of hydrophytic vegetation typically adapted for life in saturated soil conditions..."

(National Food Security Act Manual, 1988)

Fish and Wildlife Service's Wetland Classification System

The FWS, in cooperation with other federal agencies, state agencies, and private organizations and individuals, developed a wetland definition for conducting an inventory of the nation's wetlands. This definition was published in the FWS's publication ***"Classification of Wetlands and Deepwater Habitats of the United States"*** (Cowardin, et al., 1979):

"Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is often covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes:

- 1) at least periodically, the land supports predominantly hydrophytes,
- 2) the substrate is predominantly undrained hydric soil, and
- 3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year."

Summary of Federal Definitions

The CE, EPA, and SCS wetland definitions include only areas that are vegetated under normal circumstances, while the FWS definition encompasses both vegetated and non-vegetated areas. All four wetland definitions are conceptually the same; they all include three basic elements - a hydroperiod, hydrophytic vegetation, and hydric soils - for identifying wetlands sites.

Considering the broad definitions as previously stated, the forested bottomland and wetland types for Mississippi have been categorized under four major site classes based on hydrologic and soil conditions. *These broad site classes may include areas that are not presently in bottomland hardwood forest; however, field determinations should be assessed using additional indicators as discussed in other parts of this handbook and the *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* (January, 1989) and any other appropriate manuals.

* Site classes listed below are based on flowing or non-flowing water and whether the soil is mineral or organic in nature.

I. Flowing Water

A. Water systems with mineral soils

Alluvial Soils

B. Water systems with organic soils

1. Black Water River Bottoms
2. Branch Bottoms
3. Cypress/Tupelo Swamps
4. Muck Swamps

II. Non-flowing Water

A. Water systems with mineral soils

Wet Hammocks

B. Water systems with organic soils

1. Cypress/Tupelo Swamps
2. Muck Swamps

HYDROLOGY OF MISSISSIPPI

INTRODUCTION

Water is the driving force of the bottomland hardwood community. It plays an important role in the formation and maintenance of the flood plain by transporting and redistributing sediments within the system. The rivers and their floodplains are a continually fluctuating water level ecosystem. Their high flows are brought about by winter-spring rains. Their low flow is attributed to high evapo-transpiration during late summer and dry fall months.

Alluvial Rivers

Alluvial rivers in the southeastern U.S. originate in the mountains and the Piedmont and form large, wet, natural areas where the Piedmont and Coastal Plain meet. These rivers have periods of sustained high flow resulting from the cumulative effect of many tributaries and large drainage areas. At times the annual high winter-spring runoff overflows the floodplains. Differences during wet and dry periods of the year are often dramatic. Water flow may be insufficient to generate a rise and in some cases flow may decrease and water levels fall as it flows through the floodplain toward the mouth of the river. Evapo-transpiration after March leaf-out and surficial aquifer recharge may account for some of this flow reduction.

Blackwater Rivers

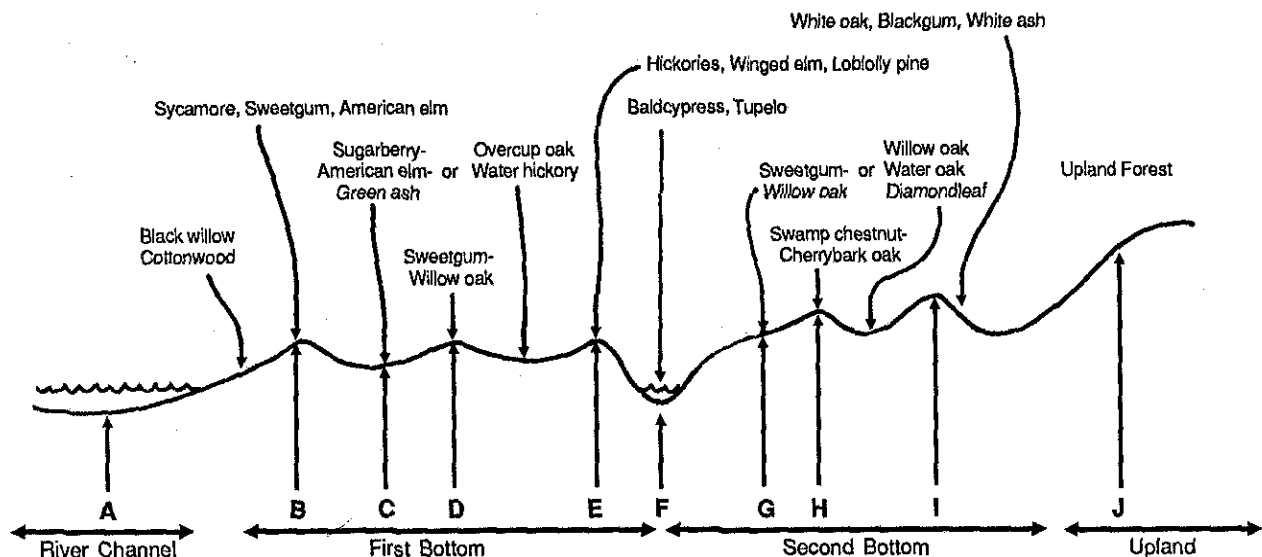
Blackwater rivers and tributary streams originate in the Coastal Plain and receive most of their discharge from local precipitation. These streams have narrower, less well developed floodplains and reduced sediment load compared to those of alluvial rivers. The waters are relatively clear, but highly tinted (coffee colored) due to the presence of organic acid derived from the hydrophytic vegetation in swamp drainages. Discharge peaks are due almost wholly to rainfall associated with frontal or local weather conditions. Local storms have major impact on summer and winter-spring flooding. Unlike that of larger alluvial streams, the blackwater stream may go through dry periods during which the flow of water may dwindle to near zero.

Bog and Bog-Fed Streams

Two swamp stream types occurring in the Coastal Plain are the bog and bog-fed stream. Bog streams generally occupy the depressions and swales between higher ridges. They also have limited distribution except in the lower Coastal Plain region of the state. Bog streams are characterized by a steady lateral seepage from surrounding sand ridges. They remain constantly wet and generally support unique bog-type vegetation.

Bog-fed streams, on the other hand, flow intermittently due to the discharge from bog-filled depressions. This type of discharge generally occurs only after significant runoff from rainfall exceeds the storage capacity of the bog. The depressions which feed these type streams are areas of internal drainage underlain by clay substrata. These are not connected by streams. Water tables generally occur at the surface and the excess water from rainfall will flow into receiving bog-fed streams. There is no sediment load deposited in these streams. Therefore, few have floodplains and they resemble just shallow depressions.

Generally these areas flow rapidly from rainfall and drainage is gradual due to their basic structure. They are characterized by typical shrub and bay-type vegetation, which in itself has some effect on drainage.



The correspondence between alluvial floodplain microtopography and forest cover types: (A) river channel; (B) natural levee (front); (C) backswamp or first terrace flat; (D) low first terrace ridge; (E) high first terrace ridge; (F) oxbow; (G) second terrace flats; (H) low second terrace ridge; (I) high second terrace ridge; (J) upland. The vertical scale is exaggerated.

SILVICULTURAL TECHNIQUES FOR WETLANDS REGENERATION

Natural Regeneration of Bottomland Hardwoods

Forested bottomlands and wetlands have a tremendous capacity to naturally regenerate themselves and in some instances are not conducive to mechanical site preparation and planting equipment. For these reasons, natural regeneration is the common silvicultural practice. Successful regeneration depends on several factors, including:

- 1) recognizing the site type and its characteristics
- 2) evaluating the stocking and species composition in relation to stand age and site capability
- 3) planning regeneration options with species characteristics in mind
- 4) using sound harvesting methods that do not adversely modify natural water flow and that protect the productivity of the site while meeting the regeneration objectives

Natural hardwood regeneration utilizes and enhances the normal cycle of wetland and bottomland species succession. The forest productivity objectives of the landowner determine whether the regeneration cycle is planned to utilize the early succession species or by contrast the late or climax stage species.

Well-stocked young to middle-age stands provide more management and regeneration options than understocked old stands. Young hardwood stands regenerate with greater vigor and more success than mature climax stands. This is not to say that mature stands cannot be naturally regenerated. Stand manipulation using other silvicultural techniques will be discussed later in the text. The landowner should strive to time harvest to maximize both economic and regeneration potential. Species and stocking composition is greatly influenced by the quality of the preceding harvests and topographic position. Repeated selective harvesting without regard for regeneration usually results in declining stocking and value of desired merchantable species. This occurs because most of the desired merchantable species are shade-intolerant and do not adequately provide coppice (when greater than 16" stump diameter) and seed to allow regeneration of the intolerant species.

The shaded condition left by partial harvests encourages site occupancy by the shade-tolerant species, such as titi, holly, elm, ironwood, box elder and maple, which are of little productive timber value. Also, sugarberry and box elder are the dominant shade tolerant species in the Mississippi River Delta. Sugarberry is under-rated as

a wildlife food producer in the river-front hardwood complex of the Mississippi River Delta.

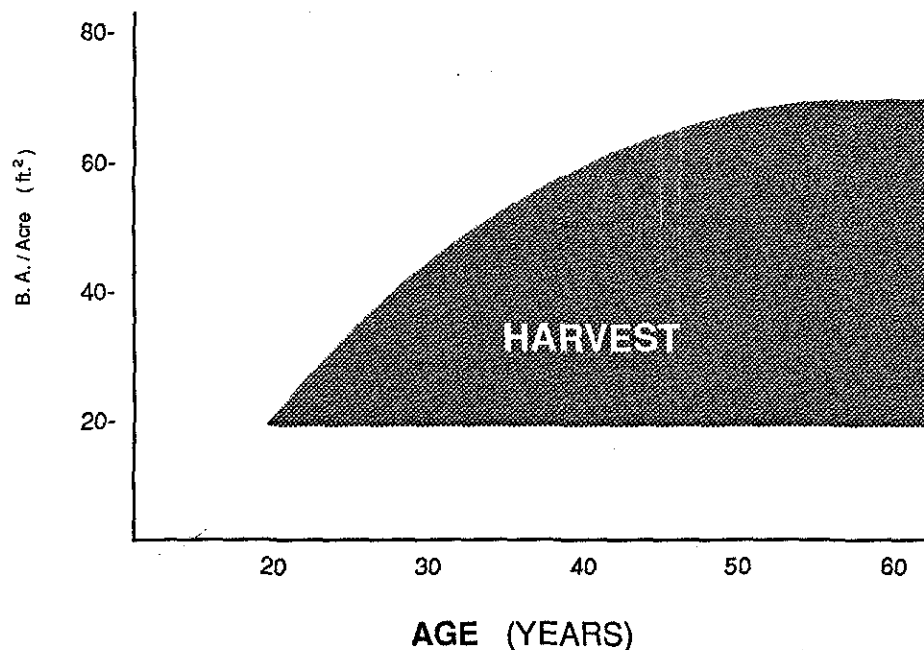
The harvesting system, which can also double as the regeneration system, must be chosen on the basis of stand and site conditions and on landowner objectives. No harvest (regeneration) system will be optimum for all stands.

When to Regenerate

Management objectives coupled with economics and forest biology determine when the regeneration harvest is needed.

The decision to regenerate understocked stands is based on the need to optimize forest productivity of the land. Hardwood stands older than 20, 30 and 40 years are candidates for harvest when basal area of desirable trees is less than 20, 40 and 60 square feet per acre, respectively. Figure 1 charts the relationship between stand age and basal area/acre of desirable hardwood species for determining stand fate.

Figure 1. Relationship between stand age and basal area/acre of desirable hardwood species for determining stand fate.



Regeneration of well stocked stands should occur when the stand reaches the maturity and value that meet the landowner's management objectives. A sound decision must be based on knowledge of stand volume and quality, site characteristics, potential site productivity, and wood markets.

Regeneration Systems

Regeneration systems commonly used with hardwoods are clearcut, shelterwood, two-aged stand, and group selection.

Clearcut

Clearcutting is the method that leaves an area cut clear in the literal sense of the word: virtually all trees in the stand, large and small, are removed. The merchantable timber is cut and all the trees that cannot be utilized profitably are severed or chemically injected according to species and size.

Clearcutting is the most effective system for natural regeneration of forested bottomland and wetland sites. The shade-intolerant species which are desired for timber production and generally for wildlife habitat (depending on favored wildlife species) are enhanced by clearcutting. It is especially applicable to stands that are below productive potential resulting from past high-grading or repeated selective harvests. Since the majority of southern hardwood stands are in a degraded condition, clearcutting, when economics allow, is recommended over other regeneration methods ***except in Streamside Management Zones or other sensitive areas.***

Care should be used in the application of this regeneration method, evaluating the existence and availability of advanced regeneration, in order to achieve results in promoting desirable species.

The size of clearcuts for regeneration purposes should consider other aspects of the surrounding stands and total environmental impact. Diversity of adjacent stands, wildlife habitat, placement of Streamside Management Zones and corridors for wildlife movement will influence decisions made concerning this method of regeneration.

Shelterwood

The shelterwood method involves the gradual removal of the residual stand in a series of partial cuts. The most fundamental characteristic of the shelterwood system method is the establishment of a new crop of trees before complete removal of the parent stand.

A shelterwood cut results in reproduction similar to a clearcut but repeated stand entry is less efficient. The potential for resource damage is also increased. Shade from the overstory trees may cause a shift of reproduction to shade tolerant species. Removal of the overstory as soon as the desired reproduction is obtained is necessary in order to achieve satisfactory results.

A preliminary cut from 3 to 10 years before final harvest is used to establish advanced reproduction from seed, seedlings or sprouts. The preliminary cut should be from below, removing midstory competition and leaving an overstory of desirable trees to cover about 30-50% (70 square feet basal area) of the area. The final shelterwood cut would remove the remaining trees. Trees of undesirable species or quality may be controlled by tree injection or girdling if cost of cutting is prohibitive.

The shelterwood system is relatively easy to implement and dominant/co-dominant trees can be retained for many years to minimize visual impacts. In aesthetically sensitive areas, final harvest can be spread over several cuts, virtually eliminating the negative visual impacts of tops, slash and stumps. Care must be exercised during intermediate cuts to avoid soil puddling and compaction, and to prevent damage to the wetland resource.

Two-Age Stand Regeneration

In this method the area is cut clear except for 4 to 12 trees per acre, or basal area of 20, 30 or 40 square feet, which are left standing to provide an aesthetically appealing site. Only a small portion of the original stand is left. After a new crop is established, residual trees may be removed in a second cutting or left indefinitely.

This is an alternative to clearcutting in aesthetically sensitive areas or where continuous mast production for wildlife is an objective of management. In this system, a few widely spaced, well formed trees are left as residuals forming an older age class of about 25 - 30 basal area at time of harvest. The remainder of the stand is cut the same as a silvicultural clearcut. This opens the stand for regeneration to develop between the residuals, thus forming a two-aged stand over time. Some regeneration will be scarified because of residual shading, but if good trees are left, they should continue to grow and increase in value according to their potential.

Regeneration occurs from coppice or from seeds of light-seeded species that are freely distributed by wind and water and remain in the duff from one to many years. For heavy-seeded species, seed distribution from a tree is confined to the ground area within the periphery of the crown. These do not develop under the shade of the parent tree. For these reasons this system is economically, biologically and often silviculturally impractical on most hardwood types.

The need for repeated stand entry, if desired to remove the seed tree cover, also makes this system undesirable for sites that remain wet.

This method should in no way be intended to be a diameter limit concept or methodology. The residual stand should be composed of a variety of species of the largest diameter, both dominant and codominant, class.

Group Selection

This modification of the selection method is more readily adapted to a wide variety of conditions because regeneration/growth requirements of most desirable timber species can be met within its framework. The size of openings created from application of the group selection technique varies and may be as small as the opening which results from the removal of two or more mature trees. Openings may increase in size to twice as wide as the height of the adjacent mature standing trees.

This is a sound regeneration system but is used infrequently because of repeated stand entry. The major difference is that trees are removed in groups which create larger openings than the removal of single trees. Openings created typically range from 1 acre up, with larger openings desired to decrease edge effects which extend inward about 1-1/2 times or twice the height of the surrounding dominant trees. Patch clearcutting of one acre or larger is an extension of group selection. Such cuttings foster reproduction comparable to that of clearcuts, providing considerable stand diversity. The system has greater application than single tree selection for environmentally sensitive areas, yet is generally not economically feasible because of low volume per acre removal. This selection method may not be a viable silvicultural method on small ownerships or ownerships which have access constraints.

Single-Tree Selection

The term "selection system" is applied to any silviculture program aimed at the creation or maintenance of uneven-aged stands. The selection method is employed for the perpetuation of such stands.

The single-tree selection method is best adapted to regeneration of shade tolerant species in all-age stands. The concept is to maintain a similar basal area in each age class; thus many trees exist in small-diameter classes and few trees exist in large-diameter classes.

Stands are entered at about 10-year intervals, with initial removal efforts being aimed at the largest and poorest quality trees. Subsequent removals are aimed at lower-quality and less desirable species down through the entire stand structure including the smallest trees. Each harvest strives to create conditions favorable for desired reproduction, enhance growth through crop tree release, and maintain desired stand structure.

Variations of this system have been advocated and employed in regenerating southern hardwoods, generally with poor success. The highest value and largest trees are harvested without control of small and undesirable trees, leaving a

progressively poorer stand with each stand entry. The single-tree selection system has value, when properly applied, in situations that preclude complete overstory removal such as stream borders, recreation areas, and locations where aesthetics are a prime consideration.

Regeneration Methods by Site Type

Forested wetlands with mineral soils are more tolerant of repeated stand entry than those with organic soils. Regeneration systems that require repeated stand entry (shelterwood, single-tree selection, and group selection) are less effective for forest wetland site types with organic soils. These types include Branch Bottom, Muck Swamp, Black River Bottom, Cypress and Cypress/Water Tupelo. Table 1 charts the effective regeneration systems recommended for each site type.

Clearcutting is precluded from primary Streamside Management Zones (SMZ) because of other management objectives. The selection and shelterwood systems are the best regeneration alternatives for restricted management areas along drainage systems.

Table 1.

**EFFECTIVE REGENERATION SYSTEMS
BY FORESTED WETLAND SITE TYPES**

SITE TYPE	*CLEARCUT	GROUP SELECTION	SHELTER WOOD	TWO AGED	SINGLE TREE
FLOWING WATER					
MINERAL SOIL					
Alluvial River	A	B	B	C	C
ORGANIC SOIL					
Blackwater River	A	B	B	C	C
Branch Bottom	A	B	B	C	C
Cypress	A	C	C	C	C
Muck Swamp	A	C	C	C	C
NONFLOWING WATER					
MINERAL SOIL					
Wet Hammock	A	B	B	C	C
ORGANIC SOIL					
Cypress/Tupelo	A	C	C	C	C
Muck Swamp	A	C	C	C	C

A = HIGHLY EFFECTIVE

B = EFFECTIVE

C = LESS EFFECTIVE

*Evaluation of the presence of advanced regeneration should be done prior to making the final harvest decision.

Best Management Practices for Regeneration Cut

Natural hardwood regeneration can be improved by following these guidelines:

1. Schedule harvest during the dormant season to take advantage of current-year seed crops and to favor good coppice regeneration. (See Regeneration Assessment, page 16.)

a. Coppice reproduction obtained from growing season harvests will be reduced in quantity and quality compared to coppice from dormant season harvest.

b. Soil degradation from logging and residual control must be minimized at all times and especially during the dormant season when soils are commonly water-saturated.

2. Harvest the parent stand as completely as possible when clearcutting to allow maximum light for shade intolerant species.

3. Harvest trees at a stump height less than 18" when practical to encourage vigorous coppice regeneration.

4. Avoid water impoundment or drainage alteration on bottomland sites by proper road construction and keeping water channels free of logging slash and debris.

5. Where ground conditions permit following a clearcut, control residuals larger than 1.5" dbh by shearing, felling, girdling or chemical herbicides within six months of harvest to obtain benefit from the prevailing seed crop and from soil scarification resulting from logging. [Note: Herbicides should not be used on desirable residual stems from which coppice is anticipated or desired.]

6. Shearing (KG-blading) is the preferred method for obtaining natural regeneration if site conditions permit. Piling, following shearing, is not recommended except where vines are prolific. It will reduce quantity and quality of desired reproduction compared to shearing only. Shearing blade must be kept sharp to avoid shattering of stumps, which will reduce sprouting.

7. Chopping fosters poor quality coppice regeneration from sprouting species such as sweetgum. It also causes rampant spread of Japanese honeysuckle (except in the Delta) and other vines which may be undesirable from a timber management perspective.

However, chopping may be desirable for the promotion of desirable browse and critical habitat development for wildlife.

Regeneration Assessment

Assessing the success of a regeneration harvest requires patience and understanding of the natural plant succession for that particular forest site. During the first ten years many wetland sites are an impenetrable combination of desirable and undesirable trees, vines and briars, as well as other annuals and perennials. Desirable tree species begin to express dominance during the next ten years.

Clearcutting results in successful hardwood regeneration on desirable sites when properly applied. Failures are usually related to soil degradation or drainage alteration. Altered water tables usually cause reversion of a site to less desirable species or non-timber pioneer vegetation; or it can work in reverse; example: from an overcup/bitter pecan site to a more desirable red oak/green ash site. Artificially raised or lowered water tables caused by activities such as poor road construction, blocked stream channels, poor logging practices, or beaver dams have the greatest negative impact.

Late succession or climax stage species generally will not appear as a dominant part of the pioneer or early regeneration species mix. This is a normal process and not an indication of regeneration failure. The site must go through the natural succession process before the climax species become a dominant part of the stand. Also, older trees or trees greater than 12" dbh do not coppice as readily as trees younger and less than 12" dbh. Regenerating sites at younger ages can provide greater regeneration vigor and success than delaying regeneration of sites until stands reach physiological maturity with complete canopy closure and the loss of advanced regeneration. Regenerating and maintaining sites with young stands (minimum age 65) also will provide dynamic, vigorous plant communities, thus maximizing their ecological functions in these important ecosystems.

ARTIFICIAL REGENERATION OF BOTTOMLAND

The success of artificially regenerating hardwoods depends on some extremely critical factors. These factors must be carefully considered during the general assessment of the area and are particularly relative to areas that have been out of timber production for some length of time. However, it should be noted that some artificial regeneration methods can be used to enhance the stocking levels of desirable species when other methods of natural regeneration are used.

Critical factors such as matching species to the appropriate soil type must be considered when planting or direct seeding for artificial regeneration.

Site Evaluation Considerations

Numerous publications are available to assist in identifying soils and matching appropriate timber species. U.S. Soil Conservation Service soil survey maps to identify soil series are also available. Soil series must be identified in order to use the soil/site/species guide developed by Walter Broadfoot. Where SCS maps are not available, use of the guidelines developed for 14 bottomland species by Broadfoot and Baker is required to make the proper selections.

In general, silt loam bottomland soils usually indicate a well drained but moist site. Unless there are special considerations such as high pH or a nutrient deficiency, silt loam soil is suitable for nearly all bottomland species.

When considering conversion of agricultural wetland sites to forested wetland sites, plow pans may occur between 8 to 12 inches deep in medium textured soils. The best growth occurs when these sites are subsoiled and the hardpan fractured prior to planting.

Clay soils indicate a low site that has been, and likely still is, periodically covered by standing water. Such soils are usually best planted to water tolerant species like green ash and nuttall oak. Clay soils also become extremely dry during mid to late summer and the species that are most tolerant to excessive moisture also perform better where there is very little available moisture.

Water - When possible, duration, timing, and depth of water covering the sites during each of the 5 preceding years should be determined. Species to be planted should be selected according to the deepest rather than the shallowest level of flooding. Species are listed below according to their tolerance to spring and summer flooding.

FLOOD TOLERANCE

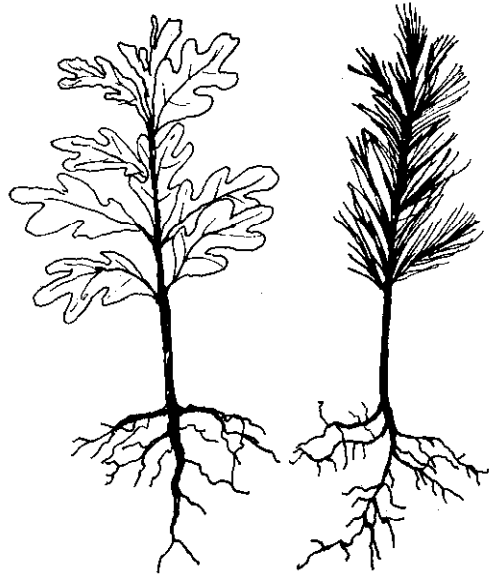
Jan. - June	Jan. - May	Jan. - May	Jan. - April	Jan. - March
Cypress	Green ash	Sweetgum	Sawtooth oak	Shumard oak
Overcup oak	Nuttall oak	Water oak	Sycamore	Cherrybark oak
Water hickory	Persimmon	Willow oak	Cottonwood	Swamp chest-
			Sweet pecan	nut oak

Note: Keep in mind that the most water tolerant species can be planted on sites with the least amount of water but not vice versa. In other words, cypress can be planted under the water conditions listed for shumard oak, but shumard oak cannot be planted under the water conditions listed for cypress.

pH - Spot check soil pH using a field kit. Remember that most red oaks cannot be planted in soils with a pH higher than 7.0. Possible exceptions are shumard oak and water oak.

Site Preparation - Not usually necessary if area is to be hand planted, but burning and/or disking of weeds may be required to allow for machine planting. Site preparation is also helpful when it results in less competition to planted trees. Subsoiling may be required if plow pans exist in medium textured soils.

Planting Stock - Seedlings should be a minimum of 18 inches tall with a root collar diameter of 3/8-inches or larger. Root collars should be planted even with, or up to 4 inches below ground level, never above ground level. Roots of all species can be pruned, but should not be unless it is necessary to allow for planting.



Trees/Acre - A minimum of about 200 trees/acre or 15 by 15 feet spacing is needed depending on the species to be established. For species such as cypress, the minimum would be 600 per acre.



by animals, birds, wind and water.

Species Mix - Use species with similar tolerance to water and soil factors and that grow in height at near the same rate. Suggested mixtures include: (1) Cherrybark and shumard oaks, (2) Nuttall and overcup oaks, (3) Sycamore and green ash, (4) Sweetgum and water oak, and (5) Cypress, green ash, overcup oak, and nuttall oak. Mixtures can be either in alternating blocks or rows of single species or within a row. Suggested spacings allow enough room so that competition from planted stock should not be a factor for a least 10 to 15 years. Some natural regeneration will occur from seed disseminated

Post Planting Weed Control - None required except for cottonwood. Bushhogging once or twice a year between rows of trees appears to increase early growth of most species, particularly when weeds are tall and dense. Without weed control, allow 5 years for the trees to become easily visible.

Acorn Direct Seeding

The artificial regeneration method of direct seeding acorns has proven to be an inexpensive method of re-establishing oak in abandoned agricultural fields. With some species, the planting time is lengthened and can be extended well past flooding times.

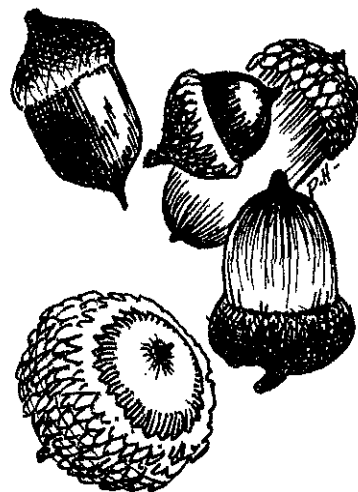
Site Selection

A key consideration is the timing and duration of flooding on a site. Shumard and Cherrybark oak acorns should be sown on well-drained soils that flood for a period of only a week or less during the growing season. As a general rule, neither species should be sown on clay soils subject to growing season flooding. Conversely, nuttall oak acorns grow well in clay soils and can withstand constant flooding from January through mid-May. Water oak acorns are less water tolerant.

Seed Collection and Storage

Seed maturity varies by species and by year, but generally acorns mature and drop from about the first of October to the first of January. The first acorns to fall are usually defective. With experience, they can be detected by their light weight and pale-colored pericarp. Acorn collection should not be delayed, since they are food for a multitude of wildlife species including deer, turkey, raccoon, squirrel, black birds, etc. A few acorns from each parent tree should be cut in the field to determine that they are not rotten, infested with insects, or underdeveloped. Acorns with holes in them are probably wormy and should be discarded.

Acorns should be placed in cold storage immediately; never leave them in a warm, dry environment such as a heated building. They should be stored in 4-mil thick polyethylene bags at about 35 degrees Fahrenheit. Nuttall acorns can also be stored in water at 35 degrees Fahrenheit, but they are the only acorns to which this storage procedure applies. If cooler facilities are not available, acorns can be stored loose or in polyethylene bags buried about 1 foot deep in the ground. After a few days of cold storage, acorns should be put in water and the floaters discarded. Sometimes with very small acorns, even good seeds will need to be cut to verify their condition.



Properly stored red oak acorns will remain viable for up to 3 years, although percent of germination may decrease. Under any long-term storage method, some acorns will germinate, but they can still be successfully direct sown--even if the

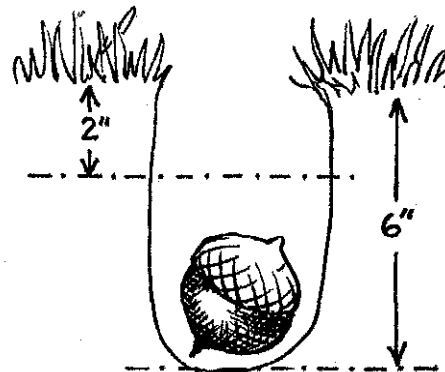
radical is broken in the sowing process. There are no reported techniques for successfully storing white oak acorns beyond a few months.

Time of Seeding

Recent research indicates that, with an occasional exception, acorns can be successfully sown any time of the year. This finding is particularly important in regenerating sites covered with water or otherwise unworkable during the dormant season. Acorns should be direct seeded after the water recedes, which for some bottomland areas could be June or July.

Depth of Seeding

Acorns of any size can be successfully sown at any depth, down to six inches. However, acorns should be sown at a depth greater than two inches and less than six inches.

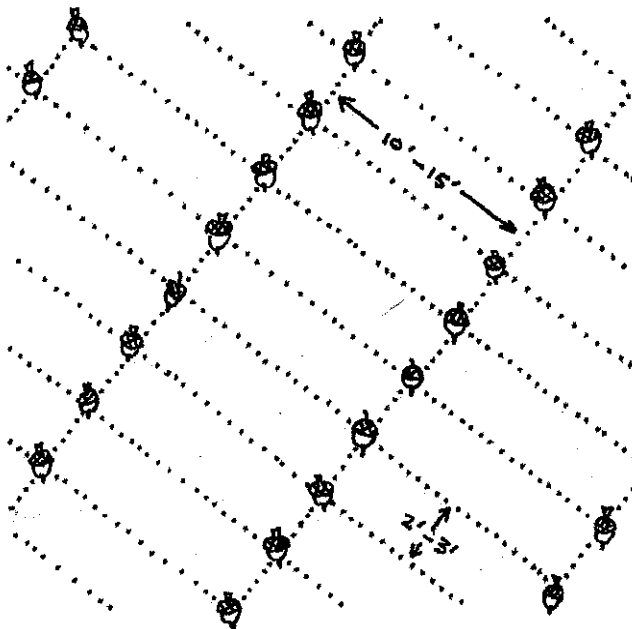


Method of Sowing

Both hand or machine seeding have been successful.

Spacing

Thirty five percent germination is a reasonable expectation for acorns. Sowing about 1,500 acorns per acre would provide for a first-year stocking of 500 seedlings, with 150 to 375 free-to-grow trees in ten years. Spacing should range from 3 by 10 feet to 2 by 15 feet.

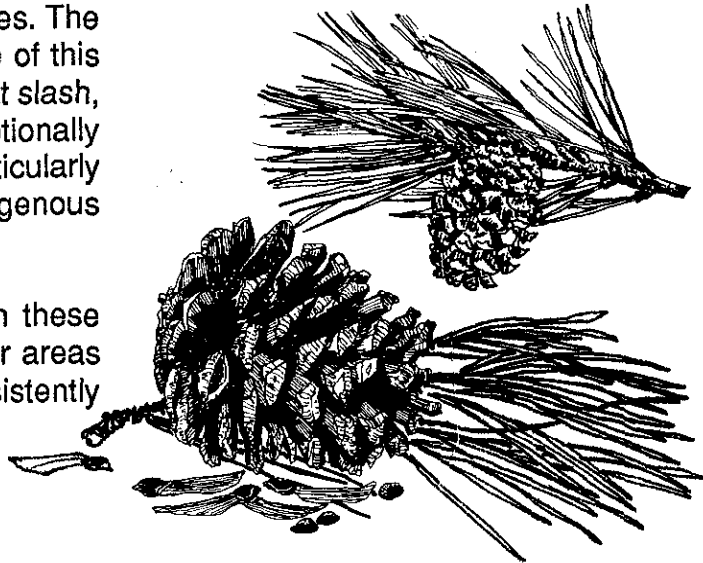


When considering the total impact on the ecology of the area, especially wildlife habitat and the restoration of hydrologic functions of these forested sites, regeneration either natural or artificial is an environmentally sound decision. The diversity created by these reforested areas can provide impacts that may not be measurable in immediate economic returns.

REGENERATION OF OTHER DESIRABLE WETLAND SPECIES

There are sites that could be categorized as wetlands sites that also grow desirable species other than hardwoods. Softwoods, such as pine, grow well when established on some of these sites. The Pearl River Basin is an example of this type area. The soils are such that slash, loblolly, and spruce pine do exceptionally well. Some of these species, particularly loblolly and spruce pine, are indigenous to the Pearl River Basin.

The establishment of pine on these sites should be left to the higher areas that neither flood nor stay consistently wet year round.



Site Preparation

Site preparation on these areas can be extremely detrimental to the hydrology of the site. Care should be used in selecting methods such as bedding and shearing and raking.

Bedding should be done on the higher sites only to the degree needed to establish the microsite for the planting of the seedlings. This method can have serious effects if drainages are created to remove excessive amounts of water rapidly. The beds should be no more than 12" to 15" high, running parallel to the natural drains.

Shearing and raking to establish pine needs to be done only in cases where logging residues are heavy. Care should be exercised not to disturb the soil. The areas adjacent to natural drains should not be used to windrow slash. The shearing blade must be kept sharp so as to cut stumps and not push them up, thus creating pockets or holes in the area.

Aerial application of herbicides should be avoided adjacent to natural drainages and sloughs. This will minimize the threat of contamination of the water course.

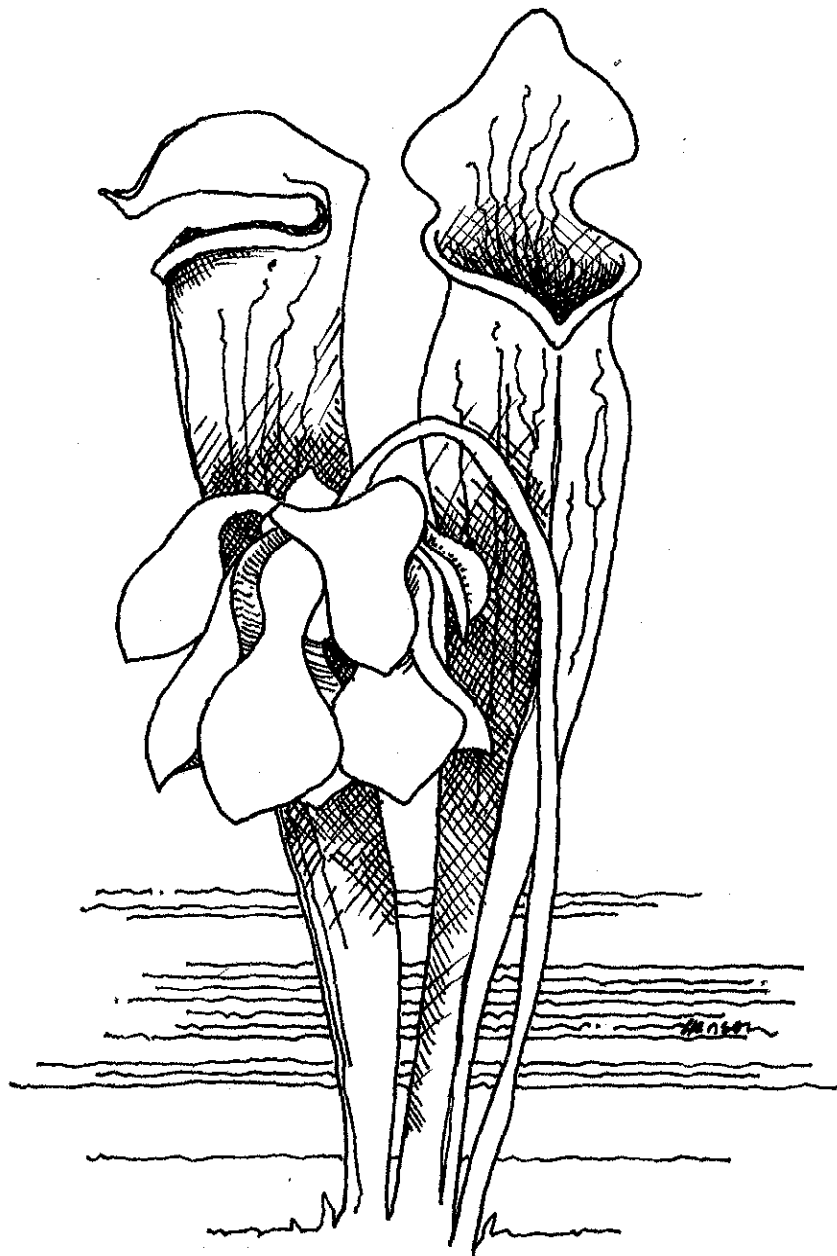
NOTE:

In considering the regeneration of other desirable wetland species on these sites one must remember that hardwoods and hardwood shrubs can grow naturally in these areas and that competition may sometimes be severe. Hardwood sprouting

on these sites should be accepted as part of the overall ecology of the area if the area is best suited for growing mixed stands.

Management decisions concerning regeneration are basically considerate of soils and particular species. A knowledge of both is needed to be successful.

A list of plant species that naturally occur in Mississippi wetlands is available from the U. S. Department of the Interior, U.S. Fish and Wildlife Service, Jackson, Mississippi.



HARVESTING BEST MANAGEMENT PRACTICES

Planning Operations

It is important for forest managers to recognize that the dramatic visual impact of timber harvesting is often the cause for adverse public reaction to forestry in bottomlands.

The judicious use of Streamside Management Zones and other visual screening, along with moderate size clearcuts and prudent logging practices, should lessen the visual impact to the casual observer.

Harvesting should be planned to accomplish management objectives and regeneration plans, yet also be structured to minimize disturbances in sensitive areas such as streams, sloughs, springs and depressions. Harvesting in itself, is not regeneration, but the regeneration system depends on harvesting practices that efficiently remove the tree crop while protecting both the forest productivity and ecological functions of the site. Of primary concern when harvesting wetland and bottomland sites is the uncontrolled trafficking of heavy equipment that can excessively rut and disturb soils. The result may be impeded drainage and destruction of site productivity and wetland functions. This damage should be absolutely avoided on areas of excessive wetness.

Selecting the Harvesting System

Choose harvesting systems according to site characteristics. Table 2 charts preferred harvesting systems by site types. Conventional or commonly used logging equipment is adequate during dry periods on sites that are periodically dry.

Equipment that minimizes access lanes and utilizes cabling, low ground pressure and high flotation is desirable for sites that stay wet. These harvesting systems could be applied to all site types but their application is limited by economic considerations.

Helicopter Aerial and Cable Logging - Helicopter logging is cost effective up to one mile from the loading deck and causes the least site degradation compared to other systems. Where practical, this system should be used on the wettest sites. This method requires no support road system so natural drainage patterns and water quality are not affected.

Cable systems can be used where either helicopter logging is not available or other ground systems can not be used, thus causing the next least site degradation by confining skidding damage to widely dispersed lanes.

Conventional Skidder Logging - Conventional methods have greater impact on

most sites than either helicopter or cable systems. Skidder logging utilizes low ground pressure and high flotation tires or tracked machines and is normally used on higher sites. Continuous trafficking and skidding on areas tends to compound problems in wetland sites such as soil compaction, ponding, and puddling of water. Degradation of the site productivity is probably greatest with this method of harvest.

Table 2.

**RECOMMENDED HARVESTING SYSTEMS BY
FORESTED WETLAND SITE TYPE**

SITE TYPE	CONVENTIONAL METHODS	CONVENTIONAL W/ CONTROLLED ACCESS (**)	CABLE OR AERIAL	BARGE FLOTATION BOOM
FLOWING WATER				
MINERAL SOIL				
Alluvial River	B	A	C	C
ORGANIC SOIL				
Black Water River	B	A	C	C
Branch Bottom	A(1)	B	C	C
Cypress / Tupelo	B	A	A	A
Muck Swamp	C	A	A	A
NONFLOWING WATER				
MINERAL SOIL				
Wet Hammock	B	A	C	C
ORGANIC SOIL				
Cypress / Tupelo	B	A	A	A
Muck Swamp	C	A	A	A

A = Recommended

B = Recommended when dry

C = Not recommended

(1) = Log from the hill (high ground)

(**) = Preplanned and designated skid trails and access roads

Scheduling Harvest

Ideally, harvesting should be scheduled during times that enhance regeneration and also protect against site degradation. Harvesting during dry periods reduces the excessive rutting and disturbance of saturated soils.

Supervision of Harvest Operations

Harvesting operations, if allowed to run unsupervised, are many times more damaging to wetland or bottomland sites than to upland sites. Planning and close supervision of harvesting operations by knowledgeable personnel are needed to protect site integrity and enhance regeneration.

The flowing and nonflowing water sites with *MINERAL SOILS* (alluvial river bottoms and wet hammocks) can be grouped for harvesting considerations. These type sites dry out annually. Conventional logging systems are recommended if harvested when dry. If harvested when wet, conventional systems with controlled access or low ground pressure are recommended.

The flowing and nonflowing water sites with *ORGANIC SOILS* can be grouped for harvesting considerations. All of these sites dry out infrequently or never. Limited or controlled access is recommended. Low ground pressure, cable, or aerial systems are preferred to protect these sites from degradation.

Recommended Practices For Harvesting Operations

1. Avoid felling trees into stream channels. If trees are felled into a stream, remove all material to avoid potential interference with normal drainage. (It is also illegal in Mississippi to leave felled tree tops in a stream more than 150 feet wide.)
2. Limb, top, jump butt, and merchandise at the stump when possible rather than on the log deck. Such activities on the log deck cause increased degradation which may affect regeneration.
3. Repair skidding damage as much as practical, but especially in the drainage system.
4. Cross drain temporary roads where necessary to assure natural flow of water in the drainage pattern. (See section on **Logging and Access Roads**)
5. When practical, pile and burn debris on log decks and loading decks. Protect against wildfire! Consider stabilizing decks with grasses beneficial to wildlife. (See **Wildlife Section**)

6. Keep litter from equipment maintenance and repair (containers, filters, tires, cables, etc.) out of streams.
7. Preferably, bury or haul litter to designated dumping areas. Dispose of used oil in proper containers and remove from the site.

LOGGING/ACCESS ROADS BEST MANAGEMENT PRACTICES

Roads represent an essential element in the management scheme for large forested areas. Roads are needed to facilitate the use of heavy equipment necessary in many forest management operations. Most of all, they are needed for the removal of timber from the site and for fire protection.

Roads have the potential to adversely affect water resources on any given site. In forested wetlands, the nature of the site's hydrology lowers the risk of erosion/sediment problems (but does not eliminate such risk). However, the hydrologic conditions increase the risk of other problems, such as the diversion or restriction of natural flow patterns. As with upland silvicultural activities, roads should be constructed with considerable emphasis on building access systems which will not cause long term on-site or off-site damage. Particular care must be exercised in avoiding permanent changes in water levels and drainage patterns.

Recommended Practices for Road Construction

1. Plan in advance the access system for the site. Where possible, avoid crossing streams, sloughs and other watercourses. Each time a crossing is made there are risks of undersizing bridges or culverts, improperly designing or constructing the crossing and creating sediment production problems.
2. Utilize temporary roads in forested wetlands. Do not attempt to construct permanent roads in forested wetlands except to:
 - (a) Serve large and frequently used areas
 - (b) Serve as approaches to a watercourse crossing
 - (c) Serve as access for fire protection

If properly planned and constructed, temporary roads will have less effect on the hydrology of forested wetlands than permanent roads.

3. Construct fill roads in forested wetlands only when alternative access routes do not exist. This is especially important in wetlands with flowing water

systems. Fill roads always have the potential to restrict natural flow patterns. Roads constructed at natural ground level provide less potential to restrict flowing water.

4. Restrict the road network to that which is essential for logging. In general, roads and skid trails should be held to a minimum on sites with a dominance of organic soils, whether logged in dry or wet weather conditions, to limit potential soil damage.
5. Fill roads shall not restrict the flow patterns or volumes of water movement through forested wetlands. Culverts, bridges, fords and other appropriate structures must be installed to convey water through fill roads to provide for flood control, erosion control and to prevent potential damage to site productivity. Care must be taken to accommodate water volumes which normally occur during the wet season.
6. No fill roads should be constructed in a flowing wetland system within 500 feet of the main channel; exceptions may occur when the road is built as an approach to a permanent watercourse crossing or when construction is temporary and is following a natural level system, or when construction is designed to minimize effects on drainage.
7. Where natural stabilization will not occur quickly, fill material must be appropriately stabilized with grass or other material. Sideslopes must be sufficient to allow stabilization to occur. Fill approaches in the immediate vicinity (within 35') of a watercourse crossing should be stabilized during construction.
8. Design, construct and maintain roads so as to keep vegetative disturbance to a minimum.
9. Construct and maintain temporary road crossings so as not to disrupt migration or movement of aquatic life or jeopardize endangered or threatened species within the wetland. This includes any modification or destruction of critical aquatic or wildlife habitat.
10. All fill material used for road crossings or elevation shall be material taken from upland sources where feasible.
11. All temporary road fills shall be removed and the area restored to its original elevation upon abandonment or completion of harvesting operations.



STREAMSIDE MANAGEMENT ZONES (SMZs) BEST MANAGEMENT PRACTICES

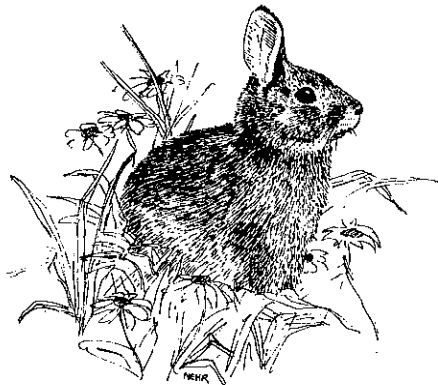
The primary goal of the SMZ should be to protect the integrity of the stream channel. Channels actively conduct the stream's flow under normal circumstances. Disturbance to the channel can affect both flow rate and direction, causing alteration of flow patterns, channel scour and erosion, and flooding.

The SMZ provides valuable protection for water temperature and sunlight regulation. The benefits of canopy cover along the watercourse are necessary to maintain proper water temperatures and degree of shading for both aquatic plant and animal life.

Specific guidelines concerning most SMZs allow selective harvesting adjacent to the streambank. Directional felling or winching with cables away from streambanks is the preferred method of harvest.

Wildlife Aspects of SMZs

In Mississippi, the majority of timberlands adjacent to watercourses are comprised of hardwoods. These areas generally provide good wildlife habitat. Many hardwood species produce large quantities of hard and soft mast and may additionally offer cavities and nesting sites for both game and non-game wildlife. These SMZs often link other forested stands together, providing protected corridors for animal movement, and diversity for habitat development. **NOTE: See WILDLIFE SECTION** for particular concerns and benefits for bottomland hardwoods with regard to increasing their value for wildlife.



Determining SMZs

Intermittent streams, recognized as having seasonal flow, may include many small drains. Often, the stream channel is not readily recognizable. But by noting vegetative changes, seasonal hydric conditions, and incised streambanks, an operator properly instructed can identify these sensitive areas. Care must be exercised when working around forested wetlands and the necessary time should be allotted to scout, locate and identify drainages where appropriate.

Care must also be taken not to overlook these minor drains. Excessive disturbance may result in increased flooding, water quality deterioration, and possibly a loss in site productivity caused by rutting and soil compaction.

Perennial streams are defined as flowing throughout the year except during extremely dry periods. These watercourses have a more clearly defined channel than intermittent streams and should be quite obvious to the land manager.

For water quality/erosion control purposes Streamside Management Zones (SMZs) should be maintained on all streams (perennial and intermittent). Streams which have an average bank-to-bank width of 30 feet or more call for a selective cut area extending out 75 feet on each side of the water channel. This selective cut should leave at least half of the canopy cover consisting of a diversity of size classes and species composition. Streams having less than an average bank-to-bank width of 30 feet call for a 35 foot selective cut zone. Mechanical and aerial site preparation should be excluded from all SMZ areas.

The larger stream or small body of water would generally require some form of bridge for crossing. The latter may, under certain conditions, be crossed with culverts, bridges or hard surfaced crossings.

All lakes and ponds greater than ten (10) acres in surface area should be considered in the same class as perennial streams having less than a 30' channel from bank-to-bank and the same guidelines followed.

The following guidelines should be included on all land areas requiring a SMZ:

1. If selective cutting is done at least half, or a minimum of 70 sq. ft. of basal area, should be left. The residual stand should consist of a species composition which is similar to that removed. Consideration should also be given to leaving trees of various heights. **NOTE: See Wildlife Section.**
2. Keep site disturbance to a minimum by concentrating skid trails outside SMZs. Cabling and winching should be used to remove harvested timber within the SMZs. If conditions exist where erosion is anticipated, take steps to stabilize these areas.
3. Mechanical site preparation should remain outside of the SMZ. Logging decks and staging areas should also remain outside of this area. Roads should be restricted to only those absolutely necessary for stream crossing.
4. Avoid crossing streams whenever possible and especially where crossings are a potential source of sedimentation. Route skid trails to avoid stream channels. When crossings are necessary they should be made at right angles to the stream and should be stabilized as soon as possible. All logging debris must be removed from the stream channel to allow unrestricted water flow.
5. Hard surface crossings or fords can be used effectively, and any approved

substrate may be used (i.e., rock, brick, concrete or logs). The crossing should not impede water flow and should be removed following harvest.

6. The broadcast application of pesticides or fertilizers is not a recommended practice within any SMZ. If a herbicide is desired, an application should be by either injection or direct application and only with approved and labeled herbicides.
7. Logging operations should be conducted during seasonally dry periods of the year.



MISCELLANEOUS MANAGEMENT OPTIONS

Precommercial Thinning (Hardwoods)

Except for some instances wherein wildlife management is the objective, the selective removal of excessive hardwood reproduction stems in young stands is not beneficial or practical. Thinning precommercial stands 20-25 years old can improve growth of residual stems but is not economical. Equipment used to thin stands can cause damage to remaining stems and degrade the site. These factors outweigh any positive thinning benefits.

Thinning (Hardwoods)

The commercial application of thinning in bottomland hardwood stands is a form of timber stand improvement where trees which are "off site," of poor quality, defective, of undesirable merchantable species and/or which are poorly positioned in the stand are periodically removed. Thinning from below is often appropriately applied to mid-to-late rotation hardwood stands for growth enhancement of the residual timber stand. Such thinnings can also be helpful in making future silvicultural prescriptions by providing a less cluttered view of the remaining forest stand.

Single Tree Selection

Single tree selection can be an applicable silvicultural management option which may be considered in the overall timber/wildlife plan for bottomland hardwoods.

However, caution should be used in implementing this particular system to insure that the long term application of this silvicultural technique does not result in the ultimate conversion of the stand to shade tolerant species, eg., boxelder or red maple, which are less desirable from an economic and wildlife utility perspective.

Fire

Prescribed fire may not be as beneficial on wetland sites as it is on upland sites for regeneration and productivity. Fire is detrimental to hardwood regeneration and productivity and is not generally recommended. Wetland sites should be protected from fire, especially during dry periods.

However, there are sites such as some pitcher plant bogs that require fire to maintain productivity and growth. Some sites that have primarily pine as the predominate species can use fire as a silvicultural tool to promote browse for wildlife and to control understory. In these situations, prescribed fire is an acceptable tool.

Care should be used to protect areas from fire where it would be detrimental to wildlife habitat, hardwood quality and growth, and where soil movement into drainages might occur.

Timber Stand Improvement

The removal of undesirable species and cull stems can improve regeneration and productivity of wetland forest stands. The removal or control of shade-tolerant non-merchantable species is especially helpful to long-term regeneration options. Felling or chipping of nonmerchantable shade-tolerant species and culls removes the crown shading and enhances reproduction during the regeneration phase.

Felling or chipping is beneficial, but resprouting occurs rapidly. The use of herbicides kills these undesirable plants and prevents coppice sprouting. Herbicide application by injection or directly to foliage or individual stems is generally more effective and preferred over soil application in wetland sites.

Wildlife Enhancement for Other Desirable Wetland Species

On wetland sites that grow desirable species other than hardwoods, specific forest management practices that enhance wildlife habitat can be used. Some softwoods such as pine grow well on some wetland sites. Where pines are the dominant stand type the implementation of certain practices can be highly desirable for habitat development.

Prescribed burning can be accomplished in pine-dominant stands at a very young age to promote browse. Special care should be taken to conduct these burns during a time that will not disturb nesting activities of certain species of wildlife. Prescribed burning should be done on 2-5 year intervals to continually provide acceptable quantities and quality of browse.

Thinning pine stands is also recognized as a management practice that promotes desirable wildlife habitat. Thinnings should be adequate so as to allow sunlight to reach the forest floor to stimulate growth of herbaceous and woody plants beneficial to wildlife. Thinnings should be conducted as often as is feasible to keep crown closure to a minimum.



The construction of firebreaks will provide added benefits to wildlife habitat. They provide access for logging and thinning operations as well as protection during prescribed burning. Firebreaks should be designed to provide diversity between stand types and when planted to herbaceous vegetation will provide additional food sources and openings for wildlife.

WILDLIFE HABITAT

The following suggestions for favoring wildlife habitat in wetland areas are not intended to satisfy all needs for all wildlife species, but rather are designed to reduce adverse impacts on wildlife habitat associated with forestry operations. It is suggested that landowners desiring to maximize wildlife benefits contact a professional wildlife biologist for additional information on management techniques for particular wildlife species.

Harvesting With Specific Wildlife Objectives

Commercial timber harvest will not cause habitat deterioration if proper management guidelines are followed (Gosselink and Lee, 1987). The size of the area harvested is often not as important as the size, shape, species composition and quality of remaining stands on adjacent forested lands. The size of the harvested area should be determined on a case-by-case basis. It is estimated that wildlife species richness will increase significantly with stand size to about 85 acres at which point it should approach a maximum level (Thomas, et al., 1979). Sufficient areas consisting of undisturbed hardwood stands adjacent to the harvested tract should remain available for wildlife. An increase in interspersion of plant communities or successional stages increases the diversity and animal use of the area (Patton, 1975; Strelke, et al., 1980).

The shape of the cut should be tailored to the specific site, using available land contours and natural barriers. An irregularly shaped cut provides increased edge, which is beneficial to many wildlife species. The harvesting plan should be structured to minimize disturbance in sensitive areas such as streams, sloughs, springs and low depressions.

When practical, locate clearcuts adjacent to timber stands which are midway through the rotational cycle. This will result in the greatest age diversity and thus maximize edge effect throughout the stand rotation, for productivity of wildlife habitat.

A mosaic of small irregular shaped clearcuts 50-100 acres each provides a large amount of edge and variety of food and cover for many species (Dickson, 1982). Patch clearcuts should be located throughout a managed stand. This provides desirable age and height diversity and a variety of vegetative successional stages to benefit a range of wildlife species. Ownership patterns, size and juxtaposition will dictate the application of this technique, as will individual objectives and featured wildlife species.

Connect mature forest stands with vegetative corridors to provide protective cover for wildlife when traveling through these type sites. The desirable width of the

corridor varies depending upon the species of wildlife being considered. Generally, the wider the corridors the greater the benefit to certain species of vertebrate and invertebrate wildlife. The importance of corridors is increased if they are wide enough to have internal habitat integrity rather than serving as narrow travel corridors (Harris and Gallagher, 1989). Uncut areas should be large enough to provide manageable units. Subsequent harvest should be conducted on a rotational basis when adjacent forest lands attain sufficient size to provide cover. Natural areas such as sloughs and streams should provide suitable travel lanes if forested buffers adjacent to these natural features are sufficiently wide to accommodate such movement. Perhaps as important as SMZ corridor width is the ability of such areas to form an interlocking continuous network throughout an area.

Snags

In areas adjacent to wetlands, a minimum of two standing snags and/or cavity trees per acre should be left for cavity nesting birds and mammals. This need may be mitigated or eliminated by the presence of continuous interlocking streamside management zones within the clearcut area.



Streamside Management Zones for Specific Wildlife Needs

The value of retaining timbered corridors along permanent and intermittent water courses has been well documented (Harris and Gallagher, 1989; Melchoirs undated report; Kundt, et al., 1988; Dickson and Huntley, 1987; Miller, 1987; Dickson, 1982). The function and perpetuation of these natural corridors should be emphasized in bottomland hardwood forest management (Gosselink and Lee, 1987). These zones may allow selective timber harvesting. However, a mixture of residual trees with a minimum of 70 sq. ft. of basal area should include various height classes and species diversity, providing both hard and soft mast producers and other key wildlife habitat components. Where canopy closure is so complete as to result in a continuous canopy closure across perennial and/or intermittent streams, SMZ width should meet acceptable wildlife minimums on each side of the stream. These SMZs are also very beneficial for water resource protection and are included in guidelines developed for non-point source pollution and water temperature control.

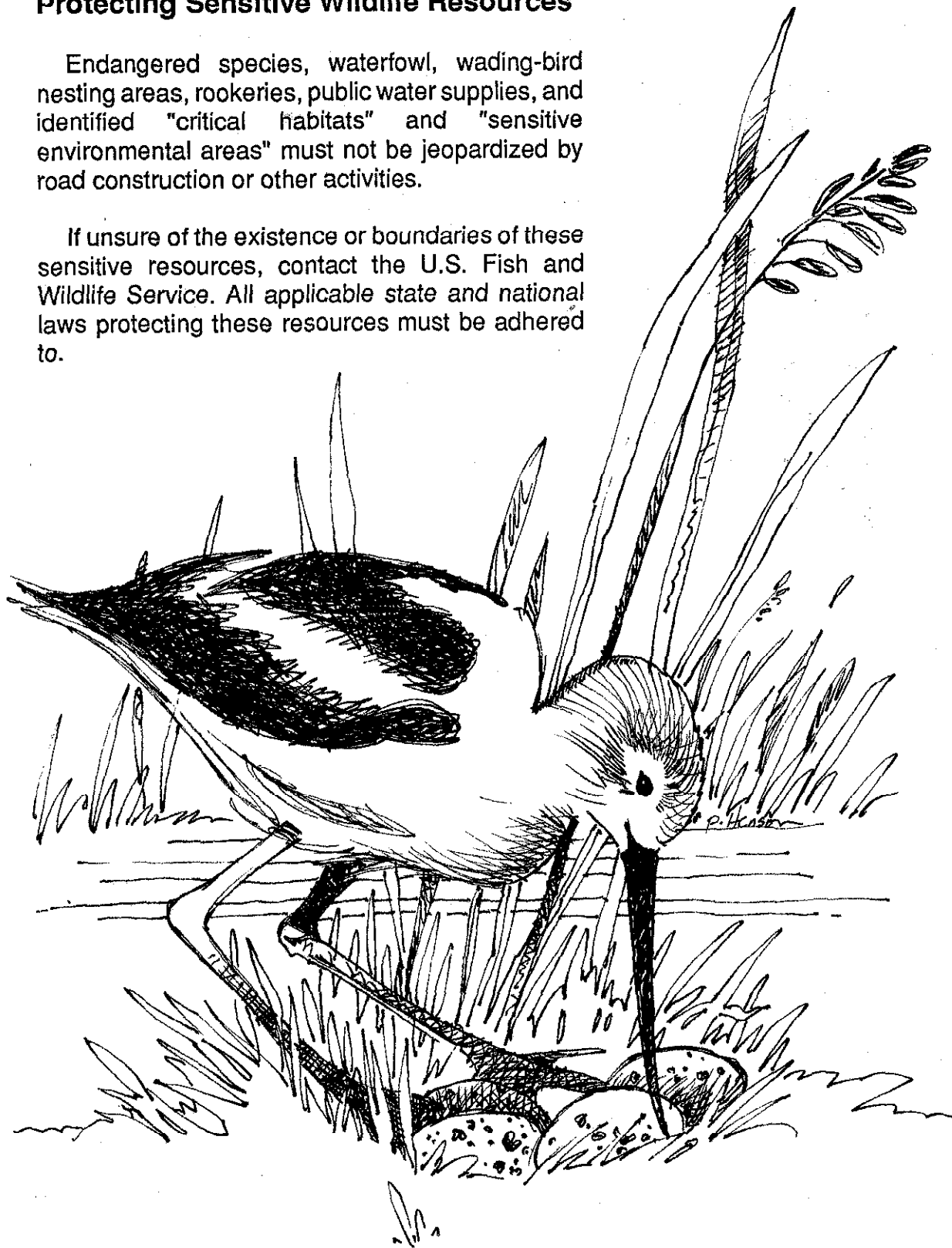
Roads and Logging Areas for Wildlife

All unneeded roads should be closed and stabilized with vegetation suitable for wildlife forage (e.g., bahia grass, vetch, clover, partridge pea, lespedeza, winter rye, rye grass). Seasonal mowing may aid in maintaining the wildlife benefits of some of these plantings. Log landings and skid trails can also be made attractive to wildlife by stabilizing these areas with the above mentioned vegetation.

Protecting Sensitive Wildlife Resources

Endangered species, waterfowl, wading-bird nesting areas, rookeries, public water supplies, and identified "critical habitats" and "sensitive environmental areas" must not be jeopardized by road construction or other activities.

If unsure of the existence or boundaries of these sensitive resources, contact the U.S. Fish and Wildlife Service. All applicable state and national laws protecting these resources must be adhered to.



DESCRIPTION OF FORESTED WETLANDS

BROAD SITE CLASS: FLOWING WATER AND MINERAL SOIL

WETLAND TYPE: ALLUVIAL RIVER

Physical description: The alluvial sites are usually located in the floodplain of major rivers whose headwaters are in Tennessee and north Mississippi. Sloughs and oxbow swamps are commonly interspersed. Levees of the riverbank are somewhat higher, but flood periodically from large seasonal rains within the watershed. Examples are the Tombigbee, Pearl, Big Black and Yazoo Rivers. The other major river system of which Mississippi only holds partial claim is the Mississippi River along the state's western border. Sites described here are common despite the clearing and channelization that has occurred over the years.

Forest Vegetation-Productivity: The species diversity of the floodplain develops in response to small relative changes in topography and soils and will follow parallel to the main stream.

Mature forest trees in the depressions of sloughs and oxbows include cypress, blackgum, tupelo gum, ash and, on higher sites in the Mississippi Delta, some hackberry (sugarberry) and boxelder. Early successional tree species include cottonwood, willow and river birch.

Forest productivity is low to average relative to other sites.

Soils: This wetland type is characterized by turbid sediment-bearing water flowing in well-defined channels and sloughs with overland flow during the peak of spring floods, but at very low levels during the fall. Early season flooding occurs on the levees and first terraces. Deposits of sediment are common in these areas along the main channels and oxbow lakes. Levee soils range from the Alga (coarse-sandy textured) to the Mantachie, which is poorly drained and fine loamy soil. The areas adjacent to the levee and first terrace are generally of the soil types like Urbo, Leaf, Lenoir, etc.

In the Mississippi River Flood Plain, alluvial soils are somewhat different in consistency because sedimentation is finer. These soils are of more clayey consistencies. Examples are Arkabutla, Sharkey, Alligator, Una, Bibb, etc. These soils are also found elsewhere in the state, under the same alluvial conditions.

BROAD SITE CLASS: FLOWING WATER WITH ORGANIC SOIL

WETLAND TYPE: BLACKWATER RIVER

Physical Description: This wetland is located in the watershed of major rivers. They are basically the headwaters of major tributaries that are located in the Coastal Plain. Sloughs and oxbow formations are well defined and interspersed all through the floodplain. Flooding is periodical during the spring under excessive rainfall conditions. However, a higher levee system and first terrace allows flood waters to recede rapidly. The sediment load of this wetland class is low. Examples would be the Noxubee, Strong River, Chunky, Bogue Chitto, Chickasaway and the Buttahatchie.

Forest Vegetation-Productivity: This is basically the same as alluvial with the development of the flood plain relative to the changes in topography and soils.

Mature forest trees found in the depressions of sloughs and oxbows include cypress, tupelo, swamp black gum and ash, with lower sites occupied by overcup oak and water hickory. The higher terraces and ridges in this system will also support cherrybark oak, nuttall oak, red maple and sweetgum with occasional pine (loblolly or spruce). Successional pioneer tree species include willow, red maple and sweetgum.

Soils: The flowing water is characterized by darkly colored water with low turbidity in well-defined channels. Overland flow is only during seasonal flooding. Significant ground water movement occurs throughout the year. Some semi-permanent flooding occurs in the oxbows and sloughs. These areas usually parallel the stream channel. Soils found in this wetland type are Alga on the levees to Johnston and Dorovan on the lower sites away from the stream. Others found in this formation are Leaf and Lenoir.

WETLAND TYPE: BRANCH BOTTOM

Physical description: This wetland situation is generally near headwaters and on major watershed floodplains. It, as other major types, has characteristic small sloughs and oxbows along the main channel. They are dominated by constant seepage or spring-fed systems with minor flooding during the wet seasons.

Forest Vegetation-Productivity: The major forest canopy is a mixture resembling that of the major river floodplains with the exception of muck swamps.

Mature forest trees include swamp black gum and cypress near drainages, overcup oak, water hickory, sweetbay and red maple. On the slightly higher sites,

species can include sweetgum, slash and spruce pine, water and willow oak, laurel oak, swamp chestnut oak and green ash.

Forest productivity is average compared to other similar types.

Hydrology and Soils: Drainage in these areas is usually year-round when fed by significant ground water sources. The bays of headwater areas are semi-permanently flooded with permanent water, occurring in seepage depressions and sloughs.

Soils are commonly more hydric in nature with some predominance of the Bibb soils.

WETLAND TYPE: CYPRESS/TUPELO

Physical description: These sites occur in a linear sequence of depressions parallel in most instances to a major drainage. There are large areas that are classified as this type that occur on all drainages that flow into black water rivers. Examples of this type can be found along the Pearl and Pascagoula Rivers.

Forest Vegetation-Productivity: This site is predominantly cypress with a mixture of swamp tupelo, black gum, sweetbay and redbay. The successional pioneer species are usually willow and red maple.

Forest productivity is average.

Hydrology and Soils: Surface water is usually flowing, even though during dry periods they may frequently dry up. They can be semi-permanently flooded during growing season.

Soil formations typical of this are Arkabutla, Bruno, Gillsburg, Guyton and others. These soils are poorly drained wetland soils that parallel the stream course.

WETLAND TYPE: MUCK SWAMP (INCLUDES: BACKWATER, SLOUGH AND OXBOW)

Physical description: These sites are areas relatively large in nature that adjoin drainages near the major watersheds. They are particularly evident along the Coastal counties as major streams such as the Pascagoula and the Pearl River get closer to their exit point into the Gulf. These are the backwater areas along these drainages and in some areas along the Mississippi and Pascagoula Rivers.

Forest Vegetation-Productivity: This site consists of soils having high organic content, and supports mature forest stands similar to that of a blackwater river

swamp. The major species include swamp black gum, cypress, water tupelo, sweetbay and redbay. The higher areas or ridges, as they are sometimes called, have red maple, sweetgum, magnolia and yucca plants.

Forest productivity is average.

Hydrology and soils: This wetland site is characterized by slow moving or standing surface water even during periods of extended drought. These sites usually remain in semi-permanently flooded condition throughout the growing season.

The soils are mainly of the Johnston series rich in organic matter. The deeper sloughs and oxbows are usually characterized by Dorovan soils.

BROAD SITE CLASS: STILL WATER WITH MINERAL SOILS

WETLAND TYPE: WET HAMMOCK (WET FLATS)

Physical description: These wetland areas usually lie between streams within a large floodplain. They have poorly developed drainage with virtually no flow of water due to constant seepage and topographic obstructions. They are commonly referred to as upland flats in the Coastal Flatwoods.

Forest Vegetation-Productivity: The major species that occur in these wet hammocks are usually evergreens such as laurel oak and water oak. Green ash, sweetgum, sweetbay and swamp black gum are also found along with southern magnolias, red maple and willow oak on the better drained sites. Typical pioneer species include willow, gum and maple.

Forest productivity is generally good.

Hydrology and Soils: High water tables exist in this wetland type. It is usually standing water with some flow during wet seasons. The ground is generally saturated and percolation is poor to non-existent.

Soil types in these sites include Smithton, Atmore, Plummer and Hyde.

WETLAND TYPE: MUCK SWAMP

Physical description: These sites are generally located in the blackwater drainages and coastal bayheads. They are basically depressions behind natural levees, ridges or other natural topographic divides within a large drainage system.

Forest Vegetation-Productivity: The dominant tree species that make up the major portion of the canopy includes cypress, tupelo gum, black gum and sweetbay. Titi and buttonbush are common site indicators within this type wetland.

Forest productivity is rather low in terms of overall timber production.

Hydrology and Soils: Standing water is generally a gradient to deeper areas and is slow to drain to an outlet even in peak periods of high water within the watershed. They play a major part in ground water recharge regardless of the effects of the water table during dry periods. Open water is common throughout this type site due to topography, with deeper parts of the swamp exposed intermittently during dry years.

The soil is high in organic content and overall very poorly drained. Soils series typical of this site are Dorovan and Ponzer.



REFERENCES AND SUGGESTED READINGS

- Federal Interagency Committee for Wetland Delineation. 1989. ***Federal Manual for Identifying and Delineating Jurisdictional Wetlands***. U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and U.S.D.A. Soil Conservation Service, Washington, D.C. Cooperative technical publication.
- Kellison, R.C., D.J. Frederick, and W.E. Gardner. 1981. ***A Guide for Regenerating and Managing Natural Stands of Southern Hardwoods***. Agricultural Resource Service, North Carolina State University, Bulletin 463: 23pp.
- Smith, D.M. ***The Practice of Silviculture, Seventh Edition***, Wiley, 1962.
- Wharton, C.H., W.M. Kirchens, and T.W. Sipe, 1982. ***The Ecology of Bottomland Hardwood Swamps of the Southeast: A Community Profile***. USDA Fish and Wildlife Service, Washington, D.C. FWS/OBS-81/37: 133 pp.
- Williston, H. L., and Russell LaFayette. ***Species Suitability and pH of Soils in Southern Forests***. USDA Forest Service, State and Private Forest Management Bulletin, July 1978.
- Baker, J. B., and W. M. Broadfoot. ***A Practical Field Method of Site Evaluation for Commercially Important Southern Hardwoods***. USDA Forest Service, General Technical Report, SO-26, 1979.
- Broadfoot, W. M. ***Hardwood Suitability For and Properties of Important Midsouth Soils***. USDA Forest Service, Experiment Station Research Paper SO-127, 1976.
- Krinard, R. M., and H. E. Kennedy, Jr. ***Planted Hardwood Development On Clay Soil Without Weed Control Through 16 Years***. USDA Forest Service, Southern Forest Experiment Station, SO-343, December 1987.
- Kennedy, H. E., Jr., and R. M. Krinard. ***Shumard Oaks Successfully Planted On High pH Soils***. USDA Forest Service, SO-321, December 1985.
- Forested Wetlands of the Southeast: Review of Major Characteristics and role in Maintaining Water Quality***. USDI, Fish and Wildlife Service, Resource Publication 163, 1986.
- Cowardin, et al. ***Classification of Wetlands and Deepwater Habitat of the United States***. USDI, Fish and Wildlife Service, FWS/OBS-79/31, December 1979.
- Dickson, J.G. 1982. ***Impact of Forestry Practices on Wildlife in Southern Pine Forests***. Pages 224-230 in ***Increasing Forest Productivity***, Proc. of the 1981 Convention of the Society of American Foresters. Orlando, FL.

Dickson, J.G., and J.C. Huntley. 1987. *Riparian Zones and Wildlife in Southern Forests: The Problem and Squirrel Relationships*. Pages 37-39 in J. Dickson and O. Maughan, eds. ***Managing Southern Forests for Wildlife and Fish***. General Technical Report, 50-65. USDA Forest Service, Washington, D.C.

Gosselink, J.G., and L.C. Lee. 1987. ***Cumulative Impact Assessment in Bottomland Hardwood Forests***. Center for Wetlands Resources, Louisiana State University, Baton Rouge, LA. LSU-CEI-86-09. 113 pp.

Harris, L.D., and P.B. Gallagher. 1989. *New Initiatives for Wildlife Conservation*. Pages 11-34 in G. Mackintosh, ed. ***Preserving Communities and Corridors***. Defenders of Wildlife. Washington, D.C.

Kundt, J.F., F.T. Hall, V.D. Stiles, S. Funderbunk and D. McDonald. 1988. ***Streamside Forests: The Vital Beneficial Resource***. Spec. Pub. Univ. Maryland Cooperative Extension Service, College Park-Eastern Shore. pp. 15.

Melchoirs, T. Undated. ***A Working Literature Review: Streamside Management Zones in Southern Pine Forests***. Unpublished report.

Miller, E. 1987. *Effects of Forest Practices On Relationships Between Riparian Areas and Aquatic Ecosystems*. Pages 40-47 in J. Dickson and O. Maughan, eds. ***Managing Southern Forests for Wildlife and Fish***. General Technical Report, 50-65. U.S.

Patton, D.R. 1975. ***A Diversity Index for Quantifying Habitat "Edge."*** Wildlife Society Bulletin, 3(4):171-173.

Strelke, W.K. and J.G. Dickson. 1980. ***Effect of Forest Clearcut "Edge" on Breeding Birds in East Texas***. Journal of Wildlife Management, 44:559-567.

Compiled and written by
Everard Baker
Private Lands Forester
Mississippi Forestry Commission

Published by

